

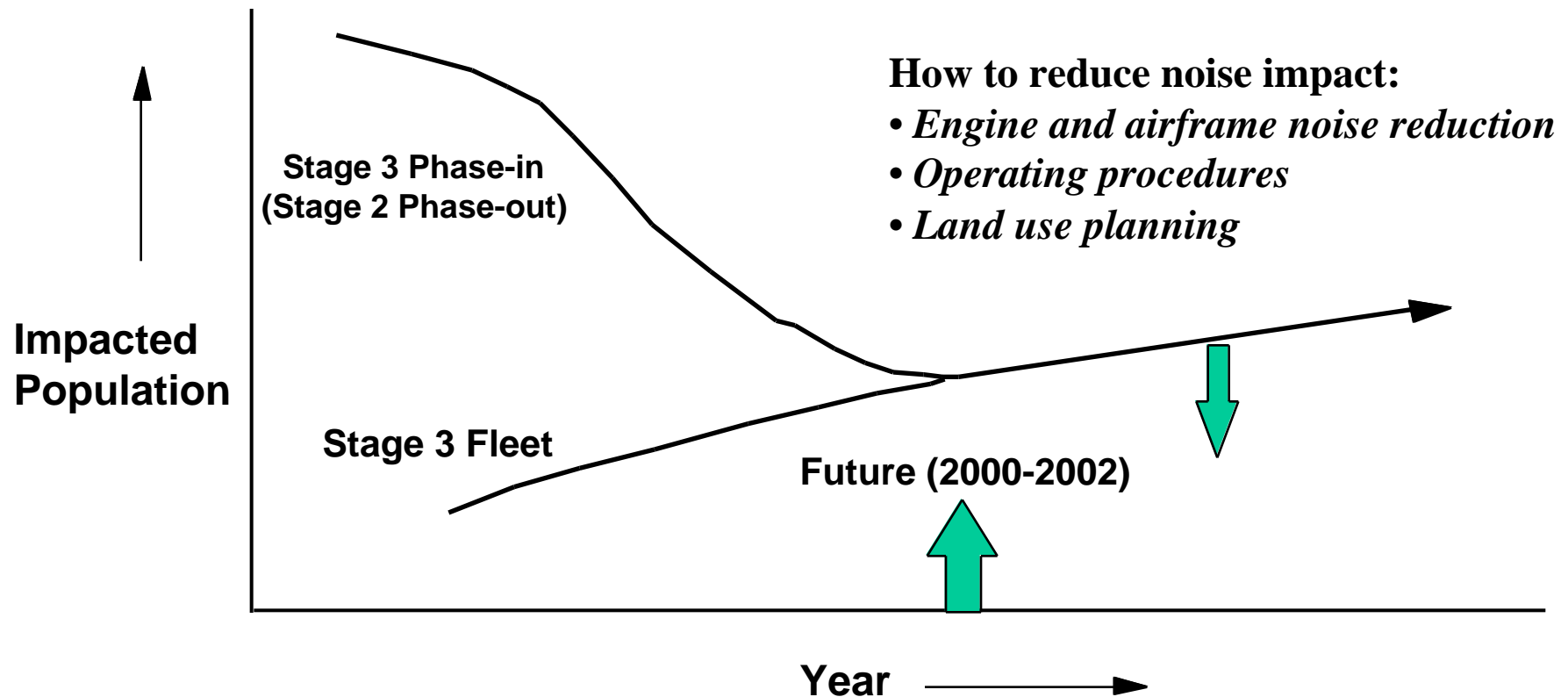
Sub-sonic Airplanes Noise Technical Issues

Belur N. Shivashankara

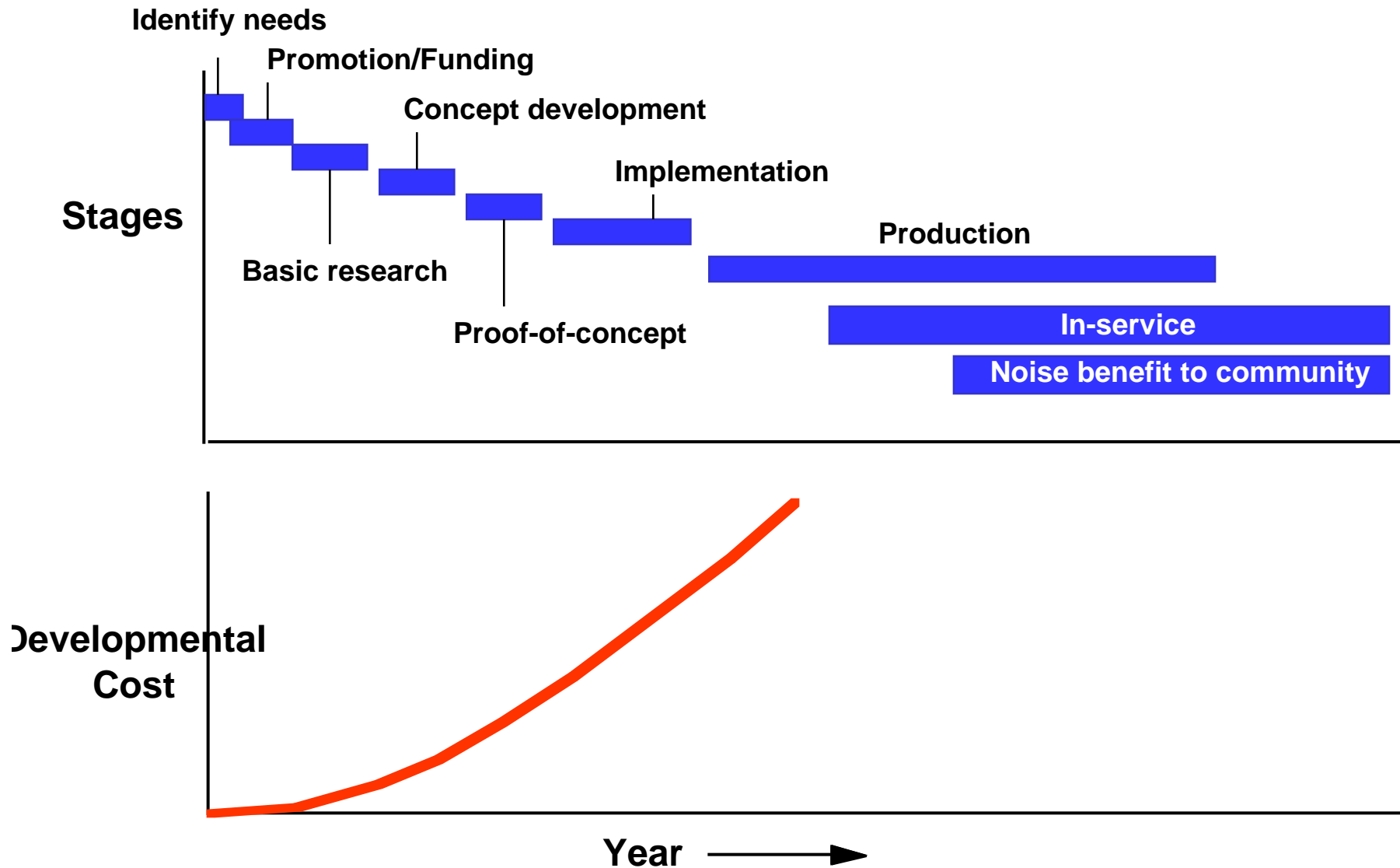
*Community Noise Technology Strategy Focal
The Boeing Company
Seattle, Washington*

March 1998

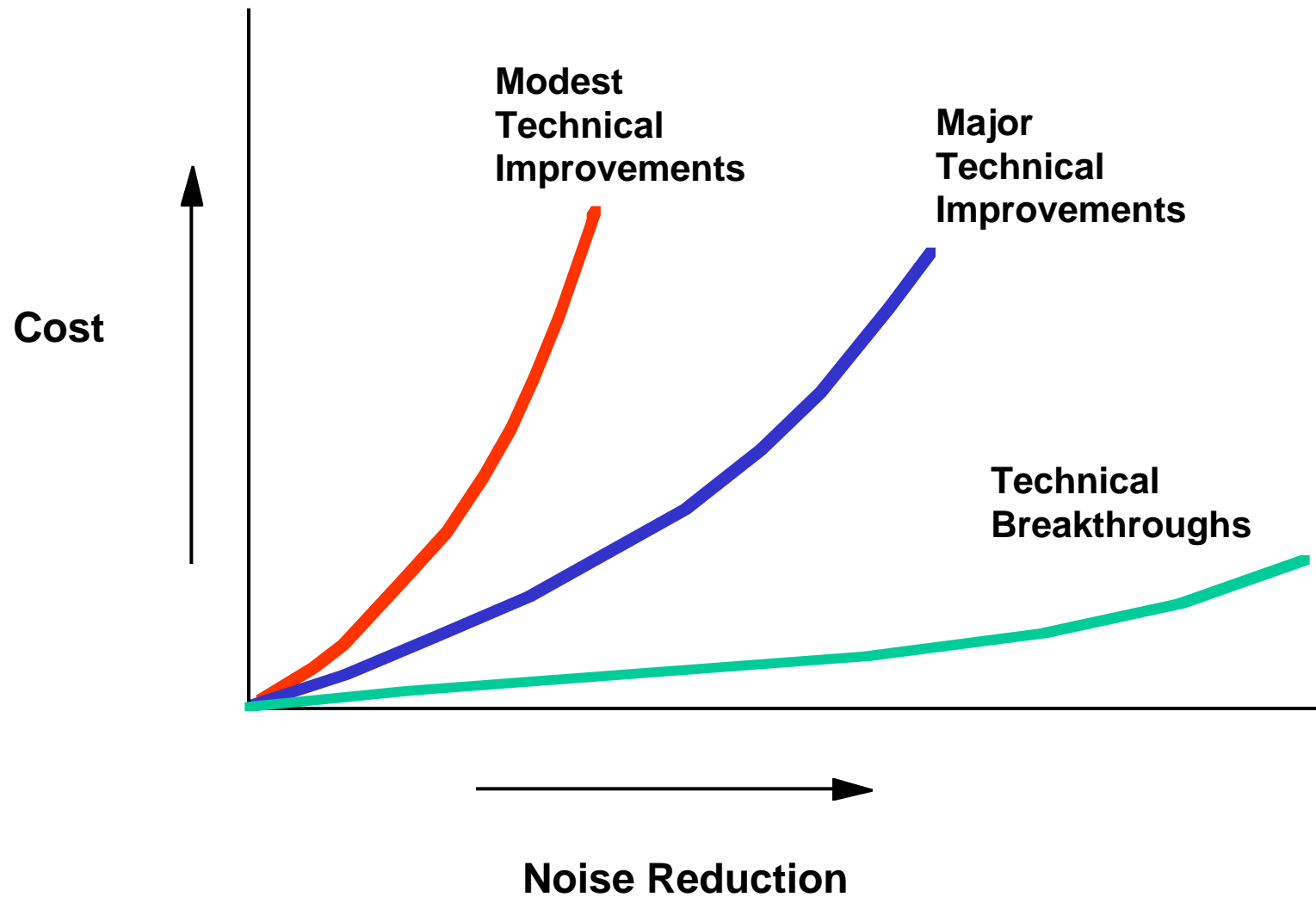
Noise improvement due to Stage 3 phase-in is gradual



Technology Implementation takes a long time and is costly



Breakthrough Technologies needed for Cost Effective Noise Solutions

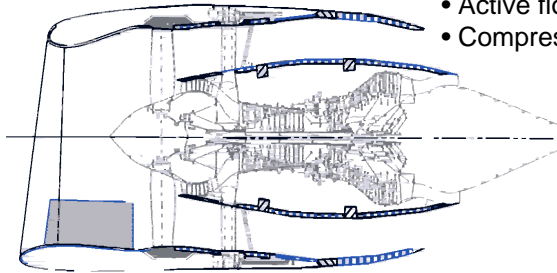


Concepts for Achieving Lower Noise

Quiet Engine Design

Current Plans

- Optimum BPR
- Advanced fan blade design
- Low noise FEGV design
- Jet noise suppressors (Chevrons, tabs)



Future Plans

- Stator bypass and inlet boundary layer control
- Quieter turbines and combustors
- Jet noise suppressors
- Active flow control
- Compressor noise reduction

Low Airframe Noise

Current Plans

- Flap/slats for low noise
- Low noise landing gear design

Future Plans

- Active flow control
- Low noise slat designs



Improved Low Speed Performance

Nacelle and Acoustic Treatment

Current Plans

- Scarf inlet
- Maximum acoustic area
- Lining designs optimized at each location for maximum impact
- Acoustic treatment for buzz-saw noise

Future Plans

- Active noise control
- Treated inlet lip
- Mode scattering linings in fan duct

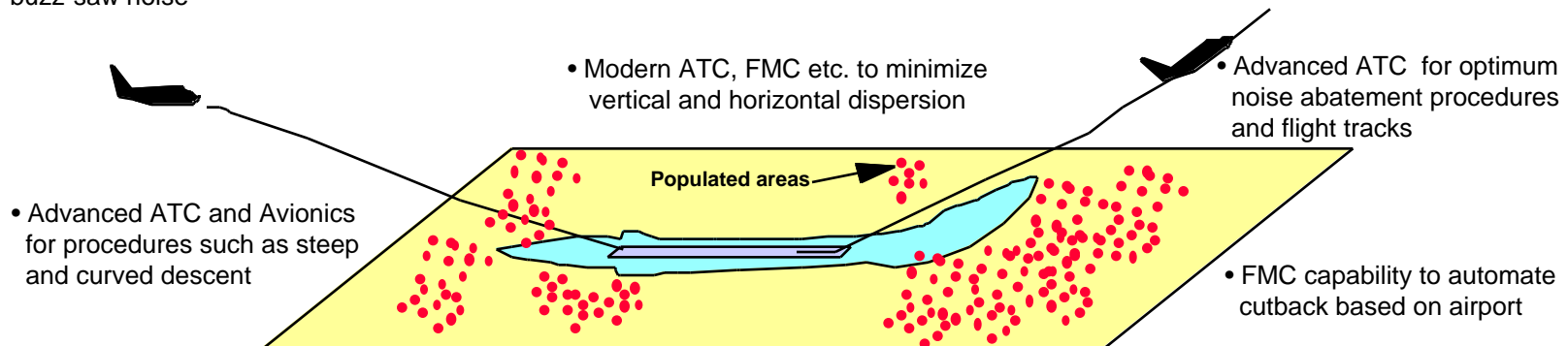
Current Plans

- Single slotted flaps
- Improved low speed L/D

Future Plans

- Drooped ailerons for T/O & landing
- Active flow control

Flight Operating Procedures for Low Community Noise (Future Plans)



Noise Exposure to Service Personnel and Crew are Emerging Issues

- **Lower ramp noise standards?**
- **Flight crew communication/fatigue**
- **Crew rest environment**
- **Cabin crew exposure limits**

Conclusion

- **A balanced approach is needed**
 - **Engine and airframe noise reduction**
 - **Optimum operating procedures**
 - **Land use planning**
- **Technical areas that need work have been identified - further discussions are needed**
- **Technology Implementation takes a long time and is costly**
- **Community realization of the benefit of new technology airplanes is gradual and takes several years to materialize**
- **The subject of noise impacting ramp crew and airplane crew should also be addressed as an environmental concern**